WE CLAIM:

1. An apparatus comprising:

a first holographic optical element having front and back oppositely facing surfaces, wherein the first holographic optical element is switchable between active and inactive states, wherein the first optical element diffracts first bandwidth light incident on the front surface thereof when operating in the active state, wherein first bandwidth light diffracted by the first holographic optical element emerges from the back surface thereof, and wherein the first holographic optical element transmits first bandwidth light incident on the front surface thereof without substantial alteration when operating in the active state;

a second holographic optical element having front and back oppositely facing surfaces, wherein the second holographic optical element is switchable between active and inactive states, wherein the second holographic optical element diffracts first bandwidth light incident on the front surface thereof when operating in the active state, wherein first bandwidth light diffracted by the second holographic optical element emerges from the back surface thereof, and wherein the second holographic optical element transmits first bandwidth light without substantial alteration when operating in the active state;

wherein the first and second holographic optical elements are positioned adjacent each other.

2. The apparatus of claim 1 wherein the front surfaces of the first and second holographic optical elements are aligned orthogonal to a common axis so that the back surface of the first holographic optical element faces the front surface of the second holographic optical element.

3. The apparatus of claim 2 further comprising a polarization rotation device positioned between the first and second holographic optical elements, wherein each of the first and second holographic optical elements comprise a diffraction grating, wherein the first and second holographic optical elements are configured so that the diffraction gratings thereof are disposed parallel to each other.

4. The apparatus of claim 2 wherein the first holographic optical element comprises a first diffraction grating, wherein the second holographic optical element comprises a second grating, and wherein the first and second holographic optical elements are configured so that the first diffraction grating is disposed orthogonal to the second diffraction grating.

5. The apparatus of claim 1 further comprising a polarization rotation device positioned adjacent the front surface of the first holographic optical element, wherein the front surfaces of the first and second holographic optical elements are substantially contained in one common plane.

6. The apparatus of claim 3 wherein the first and second holographic optical elements are configured to diffract first bandwidth light in a first plane of polarization when operating in the active state, and wherein the first and second holographic optical elements are configured to transmit first bandwidth light in a second plane of polarization without substantial alteration when operating in the active state, wherein the first plane of polarization is orthogonal to the second plane of polarization.

7. The apparatus of claim 4 wherein the first and second holographic optical elements are configured to diffract first bandwidth light in a first plane of polarization and second

bandwidth light in a second plane of polarization, respectively, when operating in the active state, wherein the first and second holographic optical elements are configured to transmit first bandwidth light in the second plane of polarization and second bandwidth light in the first plane of polarization, respectively, without substantial alteration when operating in the active state, wherein the first plane of polarization is orthogonal to the second plane of polarization.

8. The apparatus of claim 2 further comprising a control circuit coupled to the first and second holographic optical elements, wherein the first and second holographic optical elements switch between active and inactive states in response to control signals generated by the control circuit.

9. The apparatus of claim 8 wherein the first and second holographic optical elements simultaneously operate in the active state in response to an activation control signal generated by the control circuit, and wherein the first and second holographic optical elements simultaneously operate in the inactive state in response to a deactivation control signal generated by the control circuit.

10. The apparatus of claim 1 wherein diffracted first bandwidth light is emitted from the back surface of the first holographic optical element in a direction that is substantially similar to a direction of diffracted first bandwidth light emitted from the back surface of the second holographic optical element.

11. The apparatus of claim 2 further comprising:

a display device coupled to an image signal processor, wherein the display device is configured to display a monochrome image frame in response to receiving a frame of image signals generated by the image signal processor;

wherein the display device is configured to be illuminated directly or indirectly with diffracted first bandwidth emitted from the first and second holographic optical elements.

12. The apparatus of claim 11 further comprising:

a light source for generating incoherent light;

a light condenser positioned adjacent the light source and configured to condense incoherent light generated by the light source into a parallel beam of incoherent light;

wherein the front surface of the first holographic optical element is configured to receive the parallel beam of incoherent light.

13. The apparatus of claim 5 further comprising:

a display device coupled to an image signal processor, wherein the display device is configured to display a monochrome image in response to receiving a frame of image signals generated by the image signal processor;

wherein the display device is configured to be illuminated directly or indirectly with diffracted first bandwidth emitted from the first and second holographic optical elements.

14. The apparatus of claim 13 further comprising:

a light source for generating incoherent light;

a light condenser positioned adjacent the light source and configured to condense the incoherent light generated by the light source into a parallel beam of incoherent light;

a beam splitting cube positioned adjacent the condenser and the second holographic optical element, wherein the beam splitting cube is configured to receive and split the parallel beam of incoherent light into first and second parallel beams of light, wherein the first and second parallel beams of light are contained in orthogonal planes of polarization, wherein the beam splitting cube is configured to deflect the second parallel beam of light onto the front surface of the second holographic optical element, and wherein the beam splitting cube is configured to pass the first parallel beam of light without substantial deflection;

a total internal reflection prism positioned adjacent the beam splitting cube and the polarization rotation device, wherein the total internal reflection prism is configured to receive the first parallel beam of light, wherein the total internal reflection prism is configured to deflect received first parallel light onto the polarization rotation device.

15. The apparatus of claim 1 wherein the first holographic optical element is formed from polymer dispersed liquid crystal material.

16. The apparatus of claim 1 wherein the second holographic optical element is formed from polymer dispersed liquid crystal material.

17. The apparatus of claim 1 wherein the first and second holographic optical elements are formed from polymer dispersed liquid crystal material which undergoes phase separation during a hologram recording process to create regions populated by liquid crystal droplets and to create regions of clear photopolymer interspersed by regions populated by liquid crystal droplets.

18. The apparatus of claim 1 wherein each of the first and second holographic optical elements comprises a volume phase hologram recorded in a holographic recording medium.

19. The apparatus of claim 1 further comprising a control circuit and a voltage source, wherein the control circuit is configured to selectively couple the voltage source to the first and second holographic optical elements, wherein the first and second holographic optical elements operate in the inactive state when coupled to the voltage source, and wherein the first and second holographic optical elements operate in the active state when coupled to the voltage source.

20. The apparatus of claim 1 wherein the first holographic optical element comprises a layer of material that records a hologram and at least one layer of electrically conductive material positioned adjacent the layer of material that records the hologram.

21. The apparatus of claim 1 wherein the first holographic optical element comprises a layer of material that records a hologram and a pair of layers of electrically conductive material, wherein the layer of material that records the hologram is contained between the pair of layers of electrically conductive material.

22. The apparatus of claim 1 wherein the second holographic optical element comprises a layer of material that records a hologram and at least one layer of electrically conductive material positioned adjacent the layer of material that records the hologram.

23. The apparatus of claim 4 wherein each of the first and second holographic optical elements comprises a layer of material that records a hologram, and wherein the layers of material that record holograms are contained between a pair of layers of electrically conductive material.

24. The apparatus of claim 20 further comprising a control circuit and a voltage source, wherein the control circuit is configured to selectively couple the at least one layer of electrically conductive material to the voltage source.

25. The apparatus of claim 22 further comprising a control circuit and a voltage source, wherein the control circuit is configured to selectively couple the at least one layer of electrically conductive material to the voltage source.

26. The apparatus of claim 20 wherein the at least one layer of electrically conductive material comprises indium tin oxide (ITO).

27. The apparatus of claim 22 wherein the at least one layer of electrically conductive material comprises indium tin oxide (ITO).

28. The apparatus of claim 20 wherein the at least one layer of electrically conductive material is configured to be selectively coupled to a voltage source, wherein the first

holographic optical element operates in the inactive state when the at least one layer of electrically conductive material of the first holographic optical element is coupled to the voltage source, and wherein the first holographic optical element operates in the active state when the at least one layer of electrically conductive material of the first holographic optical element is not coupled to the voltage source.

29. The apparatus of claim 22 wherein the at least one layer of electrically conductive material is configured to be selectively coupled to a voltage source, wherein the second holographic optical element operates in the inactive state when the at least one layer of electrically conductive material of the second holographic optical element is coupled to the voltage source, and wherein the second holographic optical element operates in the active state when the at least one layer of electrically conductive material of the second holographic optical element is not coupled to the voltage source.

30. The apparatus of claim 11 further comprising:

a light source for generating incoherent light;

a light condenser positioned adjacent the light source and configured to condense incoherent light generated by the light source into a parallel beam of incoherent light;

a prism positioned adjacent the light condenser and the front surface of the first holographic optical element, wherein the prism is configured to deflect the parallel beam of incoherent light onto the front surface of the first holographic optical element.

31. An apparatus comprising:

a first group of first, second, and third holographic optical elements electrically switchable between active and inactive states;

a second group of first, second, and third holographic optical elements electrically switchable between active and inactive states;

wherein each holographic optical element comprises front and back oppositely facing surfaces;

wherein each of the first holographic optical elements diffracts first bandwidth light incident on the front surface thereof when operating in the active state, wherein first bandwidth light diffracted by each of the first holographic optical elements emerges from the back surface thereof, and wherein each of the first holographic optical elements transmits first bandwidth light incident on the front surface thereof without substantial alteration when operating in the active state, wherein first bandwidth light transmitted by each of the first holographic optical elements emerges from the back surface thereof;

wherein each of the second holographic optical elements diffracts second bandwidth light incident on the front surface thereof when operating in the active state, wherein second bandwidth light diffracted by each of the second holographic optical elements emerges from the back surface thereof, and wherein each of the second holographic optical elements transmits second bandwidth light incident on the front surface thereof without substantial alteration when operating in the active state, wherein second bandwidth light transmitted by each of the second holographic optical elements emerges from the back surface thereof;

wherein each of the third holographic optical elements diffracts third bandwidth light incident on the front surface thereof when operating in the active state, wherein third bandwidth light diffracted by each of the third holographic optical elements emerges from the back surface thereof, and wherein each of the third holographic optical elements transmits third bandwidth light incident on the front surface thereof without substantial

alteration when operating in the active state, wherein third bandwidth light transmitted by each of the third holographic optical elements emerges from the back surface thereof;

wherein the first and second groups of holographic optical elements are positioned adjacent each other.

32. The apparatus of claim 31 wherein the front surface of each holographic optical element is aligned orthogonal to a common axis, wherein the front surfaces of each of the holographic optical elements of the second group faces the back surface of each of the holographic optical elements of the first group.

33. The apparatus of claim 32 further comprising a polarization rotation device positioned between the first and second groups of holographic optical elements, wherein each of the holographic optical elements comprises a diffraction grating, wherein all the holographic optical elements are positioned so that each diffraction grating is disposed parallel to the others.

34. The apparatus of claim 32 wherein each of the holographic optical element of the first group comprises a first grating, wherein the each of the second holographic optical elements of the second group comprises a second grating, and wherein the first and second groups of holographic optical elements are positioned so that the first gratings are disposed orthogonal to the second gratings.

35. The apparatus of claim 31 further comprising a polarization rotation device positioned adjacent the front surface of the first holographic optical element of the first group of holographic optical elements, wherein the front surfaces of the first holographic optical elements of each group are substantially contained in a first common plane,

wherein the front surfaces of the second holographic optical elements of each group are substantially contained in a second common plane, wherein the front surfaces of the third holographic optical elements of each group are substantially contained in a third common plane, wherein the first, second, and third common planes are positioned substantially parallel to each other.

36. The apparatus of claim 33 wherein the first holographic optical elements are configured to diffract first bandwidth light in a first plane of polarization when operating in the active state, wherein the first holographic optical elements are configured to transmit first bandwidth light in a second plane of polarization without substantial alteration when operating in the active state, wherein the second holographic optical elements are configured to diffract second bandwidth light in the first plane of polarization when operating in the active state, and wherein the second holographic optical elements are configured to transmit second bandwidth light in the second plane of polarization without substantial alteration when operating in the active state, wherein the third holographic optical elements are configured to diffract third bandwidth light in the first plane of polarization when operating in the active state, and wherein the third holographic optical elements are configured to transmit third bandwidth light in the second plane of polarization without substantial alteration when operating in the active state, wherein the first plane of polarization is orthogonal to the second plane of polarization.

37. The apparatus of claim 34 wherein the first holographic optical elements of the first and second groups are configured to diffract first bandwidth light in a first plane of polarization and second bandwidth light in a second plane of polarization, respectively, when operating in the active state, wherein the first holographic optical elements of the first and second group are configured to transmit first bandwidth light in the second plane of polarization and second bandwidth light in the first plane of polarization, respectively, without substantial alteration when operating in the active state, wherein the second

holographic optical elements of the first and second groups are configured to diffract second bandwidth light in the first plane of polarization and second bandwidth light in the second plane of polarization, respectively, when operating in the active state, wherein the second holographic optical elements of the first group and second groups are configured to transmit second bandwidth light in the second plane of polarization and second bandwidth light in the first plane of polarization, respectively, without substantial alteration when operating in the active state, wherein the third holographic optical elements of the first and second groups are configured to diffract third bandwidth light in the first plane of polarization and third bandwidth light in the second plane of polarization, respectively, when operating in the active state, wherein the third holographic optical elements of the first group and second groups are configured to transmit third bandwidth light in the second plane of polarization and third bandwidth light in the first plane of polarization, respectively, without substantial alteration when operating in the active state, wherein the first plane of polarization is orthogonal to the second plane of polarization.

38. The apparatus of claim 32 further comprising a control circuit coupled to all of holographic optical elements, wherein each holographic optical element switches between active and inactive states in response to control signals generated by the control circuit.

39. The apparatus of claim 38 wherein the first holographic optical elements simultaneously operate in the active state in response to an activation control signal generated by the control circuit while the second holographic optical elements and the third holographic optical elements simultaneously operate in the inactive state in response to a deactivation signal generated by the control circuit.

40. The apparatus of claim 31 wherein diffracted first, second, and third bandwidth light is emitted from the back surface of the first, second, and third holographic optical elements of the first group, respectively, in a direction that is substantially similar to a direction of diffracted first, second, and third bandwidth light emitted from the back surface of the first, second, and third holographic optical elements, respectively.

41. The apparatus of claim 32 further comprising:

a display device coupled to an image signal processor, wherein the display device is configured to display first, second, and third monochrome image frames in response to receiving first, second, and third frames of image signals, respectively, generated in sequence by the image signal processor;

wherein the first, second, and third monochrome image frames displayed by the display device are illuminated directly or indirectly with diffracted first, second, and third bandwidth light, respectively, emitted from the first and second groups of holographic optical elements.

42. The apparatus of claim 41 further comprising:

a light source for generating incoherent light;

a light condenser positioned adjacent the light source and configured to condense incoherent light generated by the light source into a parallel beam of incoherent light;

wherein the front surface of the first holographic optical element of the first group is configured to receive the parallel beam of incoherent light.

43. The apparatus of claim 35 further comprising:

a display device coupled to an image signal processor, wherein the display device is configured to display first, second, and third monochrome image frames in response to receiving first, second, and third frames of image signals, respectively, generated in sequence by the image signal processor;

wherein the first, second, and third monochrome image frames displayed by the display device are illuminated directly or indirectly with diffracted first, second, and third bandwidth light, respectively, emitted from the first and second groups of holographic optical elements.

44. The apparatus of claim 43 further comprising:

a light source for generating incoherent light;

a light condenser positioned adjacent the light source and configured to condense the incoherent light generated by the light source into a parallel beam of incoherent light;

a beam splitting cube positioned adjacent the condenser and the first holographic optical element of the second group, wherein the beam splitting cube is configured to receive and split the parallel beam of incoherent light into first and second parallel beams of light, wherein the first and second parallel beams of light are contained in orthogonal planes of polarization, wherein the beam splitting cube is configured to deflect the second parallel beam of light onto the front surface of the first holographic optical element of the second group, and wherein the beam splitting cube is configured to pass the first parallel beam of light without substantial deflection;

a total internal reflection prism positioned adjacent the beam splitting cube and the polarization rotation device, wherein the total internal reflection prism is configured

to receive the first parallel beam of light, wherein the total internal reflection prism is configured to deflect the received first parallel light onto the polarization rotation device.

45. The apparatus of claim 31 wherein each holographic optical element of the first group is formed from polymer dispersed liquid crystal material.

46. The apparatus of claim 31 wherein each of the holographic optical elements of the second group is formed from polymer dispersed liquid crystal material.

47. The apparatus of claim 31 wherein each of the holographic optical elements of the first and second groups are formed from polymer dispersed liquid crystal material which undergoes phase separation during a hologram recording process to create regions populated by liquid crystal droplets and to create regions of clear photopolymer interspersed by regions populated by liquid crystal droplets.

48. The apparatus of claim 31 wherein each of holographic optical elements of the first and second groups comprises a volume phase hologram recorded in a holographic recording medium.

49. The apparatus of claim 31 further comprising a control circuit and a voltage source, wherein the control circuit is configured to selectively couple the voltage source to the each of the holographic optical elements in the first and second groups, wherein each of the holographic optical elements in the first and second groups operate in the inactive state when coupled to the voltage source, and wherein each of the holographic optical elements in the first and second groups operate in the active state when coupled to the voltage source.

50. The apparatus of claim 31 wherein each of the holographic optical elements of the first group comprises a layer of material that records an electrically switchable hologram and at least one layer of electrically conductive material positioned adjacent the layer of material that records the electrically switchable hologram.

51. The apparatus of claim 31 wherein each of the holographic optical elements of the first group comprises a layer of material that records an electrically switchable hologram and a pair of layers of electrically conductive material, wherein each layer of material that records the electrically switchable hologram is contained between layers of electrically conductive material.

52. The apparatus of claim 31 wherein each of the holographic optical elements of the second group comprises a layer of material that records an electrically switchable hologram and at least one layer of electrically conductive material positioned adjacent the layer of material that records the electrically switchable hologram.

53. The apparatus of claim 34 wherein each of the first holographic optical elements comprises a layer of material that records an electrically switchable hologram, wherein the first holographic optical element layers of material that record electrically switchable holograms are contained between a pair of layers of electrically conductive material.

54. The apparatus of claim 50 further comprising a control circuit and a voltage source, wherein the control circuit is configured to selectively couple each layer of electrically conductive material to the voltage source.

55. The apparatus of claim 52 further comprising a control circuit and a voltage source, wherein the control circuit is configured to selectively couple each layer of electrically conductive material to the voltage source.

56. The apparatus of claim 50 wherein each layer of electrically conductive material comprises indium tin oxide (ITO).

57. The apparatus of claim 52 wherein each layer of electrically conductive material comprises indium tin oxide (ITO).

58. The apparatus of claim 50 wherein each layer of electrically conductive material is configured to be selectively coupled to a voltage source, wherein each holographic optical element of the first group operates in the inactive state when at least one of its layers of electrically conductive material is coupled to the voltage source, and wherein each holographic optical element of the first group operates in the active state when at least one of its layers of electrically conductive material is not coupled to the voltage source.

59. The apparatus of claim 52 wherein each layer of electrically conductive material is configured to be selectively coupled to a voltage source, wherein each holographic optical element of the second group operates in the inactive state when at least one of its layers of electrically conductive material is coupled to the voltage source, and wherein each holographic optical element of the second group operates in the active state when at least one of its layers of electrically conductive material is not coupled to the voltage source..

60. The apparatus of claim 41 further comprising:

a light source for generating incoherent light;

a light condenser positioned adjacent the light source and configured to condense incoherent light generated by the light source into a parallel beam of incoherent light;

a prism positioned adjacent the light condenser and the front surface of the first holographic optical element of the first group, wherein the prism is configured to deflect the parallel beam of incoherent light onto the front surface of the first holographic optical element of the first group.

61. The apparatus of claim 30 further comprising:

a display device coupled to an image signal processor, wherein the display device is configured to display first, second, and third monochrome image frames in response to receiving first, second, and third frames of image signals, respectively, generated in sequence by the image signal processor;

wherein the first, second, and third monochrome image frames displayed by the display device are illuminated directly or indirectly with transmitted first, second, and third bandwidth light, respectively, emitted from the first and second groups of holographic optical elements.

62. An apparatus comprising:

a light source for generating incoherent light;

a condensing lens for condensing the incoherent light into a parallel beam of incoherent light, and;

a solid state optical element for receiving directly or indirectly the parallel beam of incoherent light from the condensing lens and for sequentially illuminating an image display directly or indirectly with first, second, and third bandwidth light, wherein the solid state optical element comprises at least one hologram switchable between active and inactive states, wherein the at least one hologram is configured to diffract a first bandwidth light when operating in the active mode, and wherein the at least one hologram is configured to transmit the first light without substantial alteration when operating in the inactive state.

63. An apparatus comprising:

a solid state optical element used in sequentially illuminating an image display directly or indirectly with first, second, and third bandwidth light, wherein the solid state optical element comprises at least one hologram switchable between active and inactive states, wherein the at least one hologram is configured to diffract a first light when operating in the active state, and wherein the at least one hologram is configured to transmit the first light without substantial alteration when operating in the inactive state, and;

a control circuit coupled to the at least one hologram, wherein the control circuit is configured to selectively couple a voltage source to the at least one hologram, wherein the at least one hologram is configured to operate in the active state when the at least one hologram is not coupled to the voltage source, and wherein the at least one hologram is

configured to operate in the inactive state when the at least one hologram is coupled to the voltage source.

64. The apparatus of claim 1 wherein the first holographic optical element comprises a holographic recording medium that records the hologram, wherein the holographic recording medium comprises:

a monomer dipentaerythritol hydroxypentaacrylate;

a liquid crystal;

a cross-linking monomer;

a coinitiator; and

a photoinitiator dye.

65. An apparatus comprising:

a first holographic optical element having front and back oppositely facing surfaces, wherein the first holographic optical element is switchable between active and inactive states, wherein the first optical element diffracts first bandwidth light incident on the front surface thereof when operating in the active state, wherein first bandwidth light diffracted by the first holographic optical element emerges from the front surface thereof, and wherein the first holographic optical element transmits first bandwidth light incident on the front surface thereof without substantial alteration when operating in the active state;

a second holographic optical element having front and back oppositely facing surfaces, wherein the second holographic optical element is switchable between active and inactive states, wherein the second holographic optical element diffracts first bandwidth light incident on the front surface thereof when operating in the active state, wherein first bandwidth light diffracted by the second holographic optical element emerges from the front surface thereof, and wherein the second holographic optical element transmits first bandwidth light without substantial alteration when operating in the active state;

wherein the first and second holographic optical elements are positioned adjacent each other.

66. The apparatus of claim 65 wherein the first holographic optical element comprises a holographic recording medium that records a hologram, wherein the holographic recording medium comprises:

a monomer dipentaerythritol hydroxypentaacrylate;

a liquid crystal;

a cross-linking monomer;

a coinitiator; and

a photoinitiator dye.

67. The apparatus of claim 65 wherein the first holographic optical element comprises a hologram made by exposing an interference pattern inside a polymer-dispersed liquid crystal material, the polymer-dispersed liquid crystal material comprising, before exposure:

(a) a polymerizable monomer;

(b) a liquid crystal;

(c) a cross-linking monomer;

(d) a coinitiator; and

(e) a photoinitiator dye.

68. The apparatus of claim 1 wherein the first holographic optical element comprises a hologram made by exposing an interference pattern inside a polymer-dispersed liquid crystal material, the polymer-dispersed liquid crystal material comprising, before exposure:

(a) a polymerizable monomer;

(b) a liquid crystal;

(c) a cross-linking monomer;

(d) a coinitiator; and

(e) a photoinitiator dye.